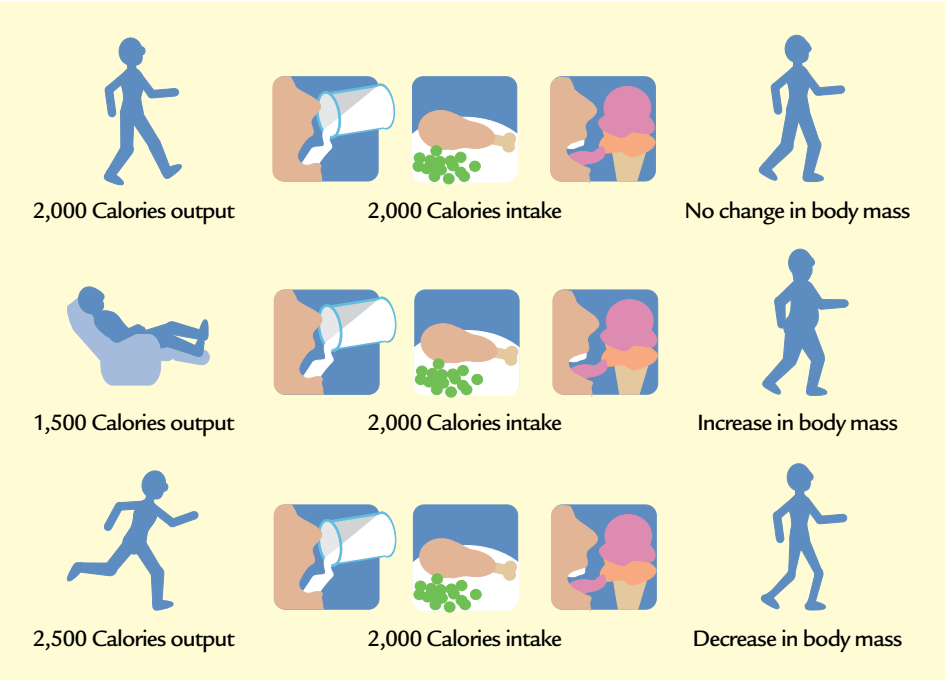
107 Designing an Energy Bar

Inventors who work on health and medical problems use engineering approaches to design new products that perform a certain job. They may have to be designed within limitations, such as the size of the product, its cost, or how it would affect other body systems.

Think about designing an energy bar. You would need to know something about the human body and how it uses nutrients for energy. You would know that the unit for measuring energy in food is the **Calorie**. Humans use (or "burn") energy all the time. Just sitting in a chair for 30 minutes can consume up to 30 Calories! The U.S. Food and Drug Administration (FDA) recommends that most kids eat about 2,200 calories each day. You get these calories from the food you eat.

Food is made up mostly of carbohydrates, fats, and proteins. Carbohydrates provide quick energy. That's why runners often eat carbohydrates just before a race ("carbo-loading"). Fats, on the other hand, store energy over long periods. It can take many days to use the energy stored in fat. Proteins are used for building muscle and other tissues. They can also be burned for energy when carbohydrates and fats are not available.

How many Calories do *you* need for energy? Consider the energy equation below.



THE ENERGY EQUATION

CHALLENGE

Can you design and make an energy bar that

- provides between 150–250 Calories?
- provides *no more* than 75 Calories from fat?
- provides *no less* than 25 Calories from protein?
- costs less than $0.75 to make?
- tastes good?
- resists crushing under the weight of a textbook?

MATERIALS

For each group of four

- various ingredients with nutritional information labels
- 1 set of measuring spoons
- 1 ¼-cup measuring cup
- 1 textbook

For each pair of students

- 1 paper plate
- 1 plastic spoon
- 1 plastic knife
- 1–2 plastic sandwich bags
- 1 calculator

For each student

- 1 Student Sheet 107.1a and 107.1b, "Energy Bar Data and Calculations"

SAFETY

Never taste materials or eat or drink in science class unless specifically told to do so by your teacher. Be sure that your work area is clean and free of any materials not needed for this activity. If you are allergic to peanuts or dairy products, or if you have any other health issue, such as diabetes, that limits what you can eat, tell your teacher and do not taste the energy bars in this activity.

Wash your hands before and after preparing the energy bars, and use only food-grade plates and utensils. Do not contaminate foods by licking your fingers or the utensils.

PROCEDURE

Part A: Designing the Energy Bar

1. Read the energy bar requirements described in the Challenge. Then look at the information provided in Table 1, "Data on Ingredients," on Student Sheet 107.1b, "Energy Bar Data and Calculations."
2. Discuss with your group what ingredients you could use to make an energy bar that would meet all of the requirements. Be sure to consider ingredients that are not listed on Student Sheet 107.1a.
3. Decide who will bring in the additional ingredients, and gather your materials.
4. Record any additional ingredients you are using in Table 1 of Student Sheet 107.1a. Use the nutritional label on the package to fill in the information for each ingredient in Table 1.
5. Calculate the cost of your ingredients for each serving. Fill in the "cost per serving" column in Table 1.
6. With your partner, write a recipe for making an energy bar. Include how much of each ingredient you plan to use.

   Hint: Try to use even amounts, such as ¼ cup or 2 tablespoons, to make your calculations easier.
7. Record the ingredients you are using and the amounts of each one in Table 2, "Calculations for My Energy Bar," of Student Sheet 107.1a. Be sure to include the units of the amounts you plan to use.
8. Use Table 2 to calculate the number of servings, calories, and cost for each ingredient.
9. Use Table 3, "My Energy Bar Totals," to find out if your energy bar would meet the calorie and cost requirements described in the Challenge.

Part B: Testing the Energy Bar

Taste Scale	
Good	4
OK	3
Edible	2
Terrible	1

10. Follow your recipe and make your first energy bar. Place the bar in a plastic bag and label it with your name and "Energy Bar 1."
11. As directed by your teacher, test the bar for resistance to crushing. Record the results in Table 4, "Evaluating My Energy Bar," on Student Sheet 107.1b.
12. Break the bar in half. Leave one half in the bag with the label. Taste the other half and rate it using the scale shown on the left. Record the results of your taste test on Student Sheet 107.1b.

13. Use the rest of your data on Energy Bar 1 to complete Table 4 on Student Sheet 107.1b. Then discuss with your group how you could improve your energy bar recipe.

14. If you have the time and materials, revise your energy bar recipe to make and test a second energy bar.

ANALYSIS

1. What are the similarities between designing a product, like the energy bar, and conducting a scientific investigation? What are the differences?

2. Which requirements did your energy bar meet? Were there any requirements that you could not meet? Explain.

3. The United States Department of Agriculture (USDA) recommends that a person eating a healthy diet consume less than 30% of his or her daily Calories from fat. For a person eating 2,200 Calories every day, this means no more than 660 Calories from fat.

   a. Copy and complete a table like the one shown below.

Energy Bar Calories and Fat

	Calories in my energy bar	Calories USDA recommends for one day	My bar's percentage of USDA recommendations
Total calories			
Calories from fat			

   b. How many of your energy bars could a person eat in one day without exceeding 2,200 Calories, assuming he or she ate nothing else?

   c. How many of your energy bars could a person eat in one day without exceeding 660 Calories from fat, assuming that he or she ate nothing else?

4. Explain whether you would recommend your energy bar as a healthy snack. Support your answer with *quantitative* evidence and identify the trade-offs of your decision.

   Hint: To write a complete answer, first state your opinion. Provide two or more pieces of evidence that support your opinion. Then consider all sides of the issue and identify the trade-offs of your decision.

5. Look again at figure called, "The Energy Equation," at the beginning of this activity. Write an explanation of how this figure helps to explain changes in body weight in terms of a balance between food (energy input) and exercise (energy use).

EXTENSIONS

1. Imagine that you are in charge of marketing your energy bar. Design an ad to sell it. What further testing and changes would you suggest before your company starts manufacturing your energy bar?

2. *Is your Calorie intake balanced by your level of activity?* Choose a food label from one of your favorite snack foods. How many Calories are provided by one serving of this food? How many servings of this food do you usually eat at one time? Multiply your answers to figure out how many Calories you usually consume when you eat this food.

Look at the table on this page, "Burning Calories." Create a weekly activity table to record which activities you do and the number of minutes you do each of them each week. Use the table (or go to the SALI page of the SEPUP website) to calculate approximately how many Calories you burn in an average week.

Choose one of your favorite activities from your weekly activity table. How long would you have to do this activity to use up the number of Calories you usually consume when you eat your favorite snack food (calculated above)?

Burning Calories

Activity	Calories
Basketball	7
Biking (12–14 mph)	7
Dancing (fast)	5
Football	7–8
Gymnastics	4
Rollerblading	6
Running (6 mph)	9
Sitting (in class)	2
Skateboarding	4
Sleeping	1
Soccer	6
Softball	4
Standing	1
Swimming laps	9
Tennis	6
Walking (4 mph)	4
Watching T.V.	1

Approximate number of calories consumed during 1 minute of activity by a 110-pound person.